

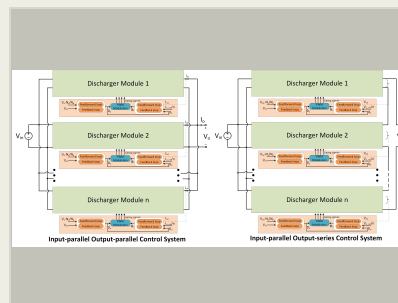
# A Universal High Efficiency Modular Discharge Over a Wide Input/Output Voltage Range for Hall Thruster Power Processing Unit, Phase I

Completed Technology Project (2017 - 2017)



## Project Introduction

Busek proposes a novel, universal, modular, 2.5kW discharge converter for Hall Effect thruster (HET) Power Processing Unit (PPU). The unique advantages of the proposed system include: (1) a wide input voltage range (28V to 100V) with a wide output voltage (150V to 400V) while maintaining high efficiency operation. Therefore, it provides a universal solution for aerospace systems with different bus voltages. (2) this modular converter will be capable of input-parallel output-series (IPOS) operation to support higher output voltage (800V-1200V or higher) and input-parallel output-parallel (IPOP) operation to support higher output power (20kW or higher). An intelligent "plug-n-play" power sharing and voltage balancing control is proposed to support the IPOS and IPOP operations. (3) the proposed converter adopts a soft-switching DC/DC topology using the advanced GaN power MOSFETs to enable high efficiency with high switching frequency operation, which leads to significant size reduction of magnetics and other passive components to push for high power density design. The targeting power density for single module is more than 1kW/kg. The Phase I effort includes design and analysis of modular discharge converter with the GaN power MOSFETs and the "plug-n-play" power sharing and voltage balancing control system to support IPOS and IPOP operation. The bread board will use COTS EEE parts. Its testing will validate the performance over the wide input/output voltage range. Two modules will verify IPOS and IPOP operation. The initial system integration test with Busek HET will also be conducted. In Phase II we will fully characterize the breadboard discharge converter with a thruster and develop a proto-flight brass-board level unit with multiple discharger modules using GaN devices. At the conclusion of Phase II we will build and deliver several discharger modules to NASA for additional characterization testing.



A Universal High Efficiency Modular Discharge Over a Wide Input/Output Voltage Range for Hall Thruster Power Processing Unit, Phase I Briefing Chart Image

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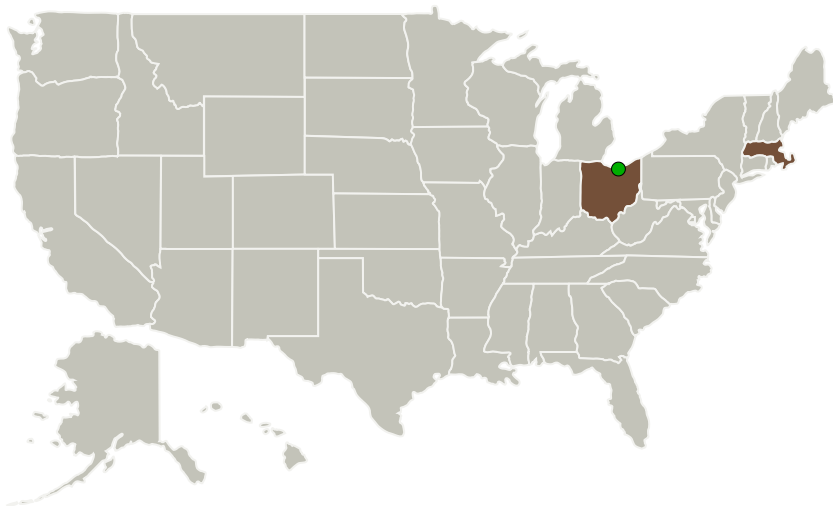
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

### Primary U.S. Work Locations

Massachusetts	Ohio
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## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Busek Company, Inc.

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

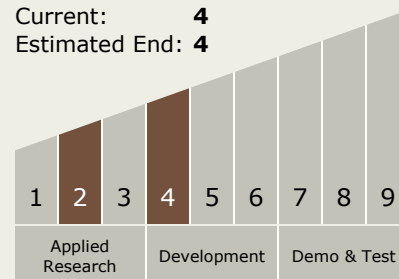
Carlos Torrez

### Principal Investigator:

Xiaohu Liu

## Technology Maturity (TRL)

Start: 2  
Current: 4  
Estimated End: 4

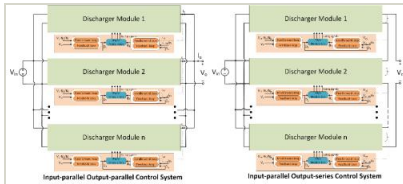


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## Images



### Briefing Chart Image

A Universal High Efficiency Modular Discharge Over a Wide Input/Output Voltage Range for Hall Thruster Power Processing Unit, Phase I Briefing Chart Image (<https://techport.nasa.gov/image/129097>)

## Technology Areas

### Primary:

- TX03 Aerospace Power and Energy Storage
  - └ TX03.3 Power Management and Distribution
    - └ TX03.3.1 Management and Control

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System